

tPNT Spectral Adjustment and HPGe Efficiency Calibration

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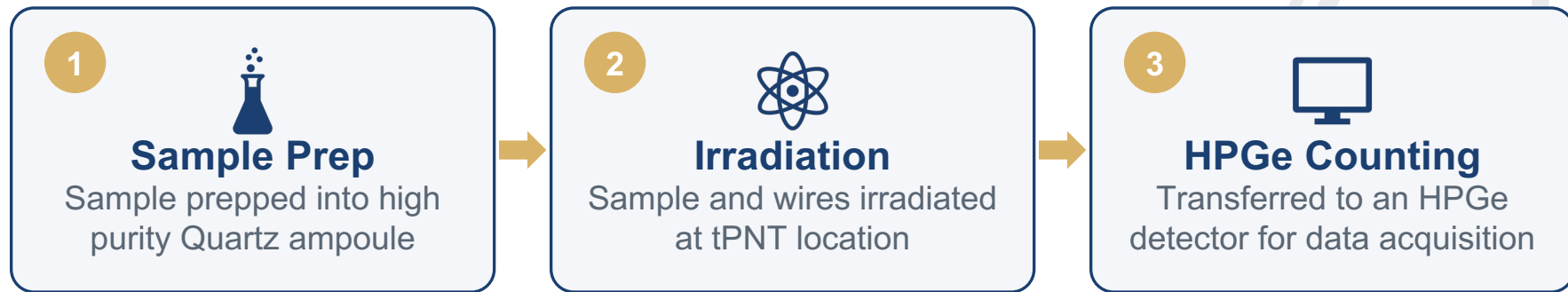


Project Background

On January 16th, 2026, Xenon 134 was irradiated at the tPNT location. Included alongside the sample of Xe-134, were dosimetry wires to act as flux monitors.

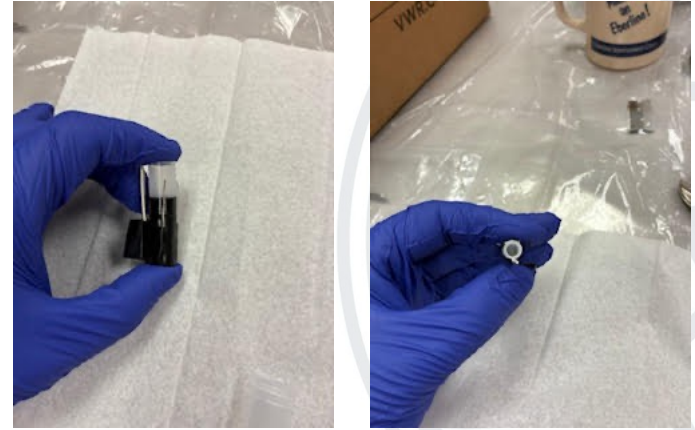


General Experimental Process



Dosimetry Wires

A 3-Group flux characterization was done using a Gold-Aluminum foil, a Nickel foil and a Gold-Aluminum foil with a Cadmium cover.



Figures 1 and 2: Wires in the rabbit

Activity of the Wires

$$A_c = \frac{C\lambda}{\epsilon f(1 - e^{-\lambda t_c})} \quad \text{Equation 1}$$

$$A_{EOI} = \frac{A_c}{e^{-\lambda t_{cool}}} \quad \text{Equation 2 (Krane, } \textit{Modern Physics} \text{ 3rd Edition, Equation 12.13)}$$

A_c = activity at start of counting (Bq)

C = net counts, background and deadtime corrected

ϵ = efficiency at the chosen peak

f = gamma branching ratio

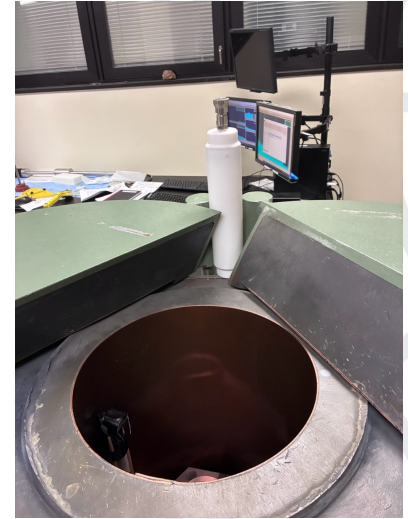
t_c = counting live time (s)

A_{EOI} = activity at end of irradiation (Bq)

t_{cool} = cooling time before counting (s)

High Purity Germanium (HPGe) Detector Efficiency

A ORTEC GMX-series HPGe detector in an ORTEC low-background Lead shield was used with a DPSEC-50 MCA to read it out. The Europium used was a point sample and was placed on the D stand (normal geometry).



Figures 3 & 4: Europium sample within the HPGe detector and its Lead shielding

Europium Efficiency Calibration Curve

Quantity	Value	σ (%)
Relative efficiency 526.6 keV / 249.8 keV	0.5524	1.62

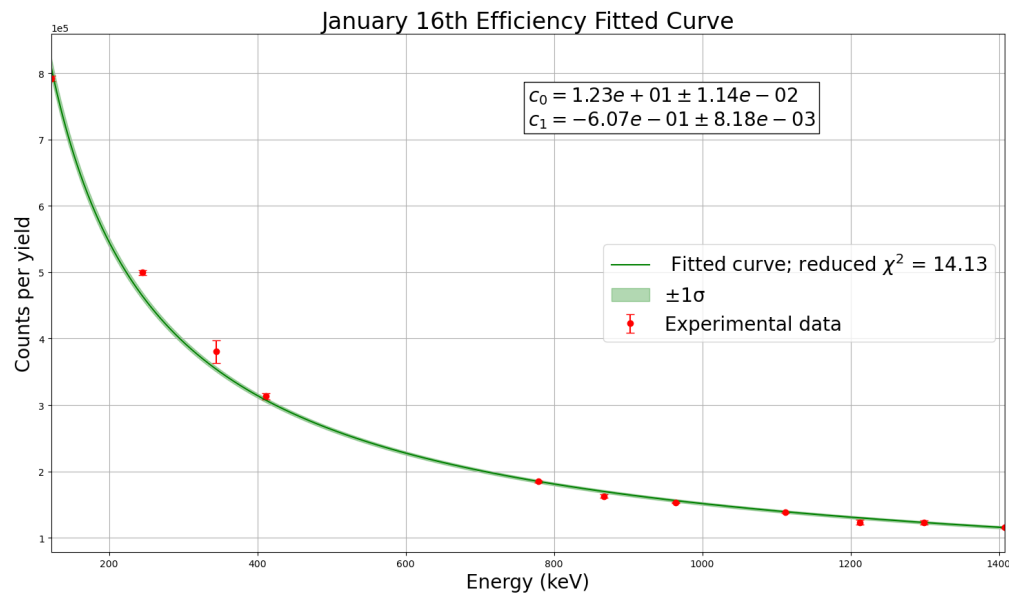


Figure 5: Europium efficiency calibration curve with fitted response

Spectral Adjustment with STAYSL PNNL

As opposed to iterative methods of flux unfolding, STAYSL PNNL applies a generalized least-squares technique to reconcile wire data at the time of irradiation with a previously generated input flux spectrum, accounting for self-shielding calculations etc.

STAYSL Output

Group	Flux ($\text{n cm}^{-2} \text{s}^{-1}$)	σ (%)
Thermal 1E-4 eV – 0.55 eV	2.69E+12	2.9
Epithermal 0.55 eV – 110 keV	6.97E+11	9.6
Fast 110 keV – 20 MeV	7.76E+11	21

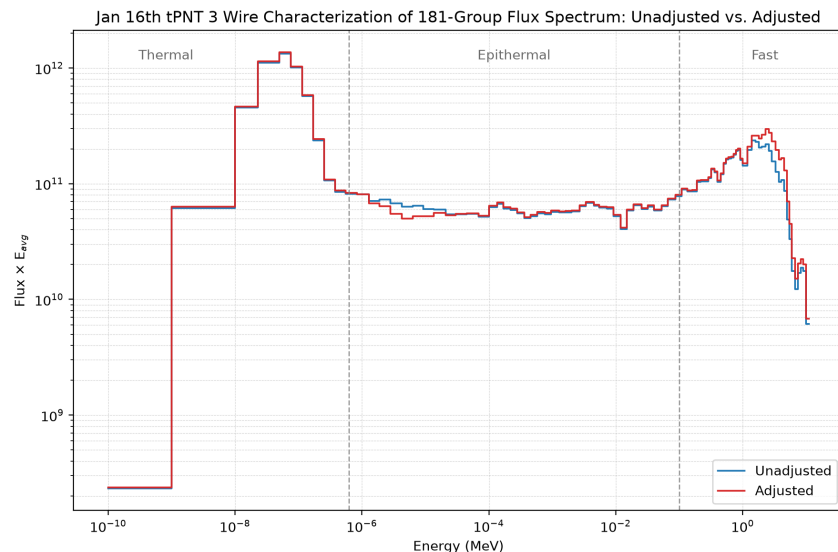


Figure 6: Unadjusted and adjusted 181-group flux spectrum from STAYSL

Acknowledgements

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